

Appendix D

Butterflies Use of Mitigation Wetlands

BUTTERFLIES USE OF MITIGATION WETLANDS

May 2007

Submitted by:

Dennis W. Schlicht and Franklin L. Olsen

Iowa Lepidoptera Project
1108 First Ave.
Center Point, IA 52213.

BUTTERFLIES' USE OF MITIGATION WETLANDS

Dennis W. Schlicht and Franklin L. Olsen

Iowa Lepidoptera Project
1108 First Ave.
Center Point, IA 52213.

Abstract: This research studied butterflies' use of mitigation wetlands in Iowa. Mitigation sites were selected for their location and relevance to the project and selected to represent a span of ages since creation. Walking surveys were conducted on each site approximately every 10 days during non-frost season. A total of sixty-one species of butterflies were seen, with the number of species at any site ranging from 43 to 16. Several conservative and wetland affinity correlated species were seen. There were correlations between high diversity/richness, to overall size, wetland ratio and association with existing natural areas.

Key Words: Butterflies, Lepidoptera, mitigation wetlands.

INTRODUCTION

Butterfly (Lepidoptera: Rhopalocera) diversity and assemblages are an indicator of the quality and type of a habitat. Poor sites in Iowa might contain 20 species of butterflies and good site might have 50 or more in a year. Typically wetlands might contain about 30 species, prairies 35, woodlands 35 and mixed habitats 50 species. Each habitat type has its unique assemblage of butterflies. While the habitat list of butterflies is not completely exclusive to that habitat, there are exclusive suites of species for each habitat. For example the Baltimore checkerspot (*Euphydryas phaeton* Drury) is obligate to the wetland plant turtlehead (*Chelone glabra* Linnaeus) but the monarch (*Danaus plexippus* Linnaeus) can be found in any habitat.

Using butterfly data, we can evaluate mitigation sites by comparing them to known comparable diversities and assemblages from non-mitigation sites. Variations in mitigation site characteristics such as physical geography, plant communities and age, can be evaluated to determine their effect on species composition at each site.

METHODS

Because butterflies fly as adults for a relatively short period, the total length of a flight for a species may be as short as 10 days for single brooded species to as long as most of the summer for continuously brooded species. Therefore, at each study site, data were

collected on the Lepidoptera species present approximately every 10 days during the non-frost season.

Site maps were studied before the season to determine the logistics for surveys. On each site we completed a walking survey to identify areas for future repeatable survey routes that might contain some species richness. Each route passed through the designated transect(s). Once the actual surveys started we followed the same approximate routes to insure comparable methodology for each repeated survey.

Survey method consisted of walking surveys of the designated routes to count all individuals of each species. Specifically we used a modified Pollard technique, walking at approximately one mile per hour, scanning an area 10 meters to the left, right, and front (Pollard 1991; Pollard and Yates 1993). We stopped the walk temporarily when individuals needed to be captured and released for identification purposes. When transects were encountered, GPS [Garmin eTrex and Garmin Map 76] and time data were taken, and transect species were recorded separate from the remainder of the walking route. Location data were also recorded for any rare species. Electronic anemometers were used to determine wind speed and direction.

All data during the walking route was tape recorded in a microcassette recorder in real time. Data for each site visit was then transcribed in the "Iowa DOT/EPA Grant" yellow field book. We then transferred this information onto individual Data Sheets. Data included site name and reference number, date, percent of cloud cover, cloud type, temperature, wind speed and direction, starting and ending times at the site, starting and ending times at the transects, all species identified and how many of each species were located.

For each site we summarized data including age of site, total size in acres, total size of wetland, type of site (reconstruction, constructed, or native/original), richness of species, abundance of butterflies, Shannon diversity index (Pielou 1977), conservatism and wetland affinity of species found (Table 1).

RESULTS

A total of 15 sites (twelve mitigation sites and three reference sites) were each surveyed 12-13 times during the project. Eight sites were surveyed in 2005 and 7 in 2006. In total 61 species were seen with a total of 8,026 individuals counted. The richest site was Badger Creek in Warren County with 43 species and 1,129 individuals. The least rich two sites were Dike in Grundy County with 16 species and 513 individuals, and Boevers in Bremer County with 17 species and 128 individuals (Table 2). No Iowa state threatened or endangered species were found. There was a correlation between high diversity and wetland ratio. (Table 3; Figure 1 and Figure 2). The Shannon Diversity indexes for the reference sites fell within the range of the mitigations with the Hay-Buhr Area and Doolittle Prairie State Preserve reference sites nearer the bottom of the list (Table 3; Figure 1 and Figure 2).

The most important wetland associated species in the study were the dion skipper (*Euphyes dion* Edwards) (7 sites), the black dash (*Euphyes conspicua* Edwards) (3 sites) and the eyed brown (*Satyroides eurydice* Linnaeus) (4 sites). Where found in association, these were the best wetland assemblage of butterflies we had in the study. Also highly significant were the sightings of the regal fritillary (*Speyeria idalia* Drury) at the Badger Creek Mitigation Site and Doolittle Prairie State Preserve. This butterfly is rare and of special concern in the tallgrass prairie region. Less important wetland associates were bronze copper (*Lycaena hyllus* Cramer) (15 sites), gray copper (*Lycaena dione* Scudder) (9 sites), long dash (*Polites mystic* Edwards) (1), two-spotted skipper (*Euphyes bimacula* Grote & Robinson) (10 sites) and the least skipper (*Ancyloxypha numitor* Fabricius) (15 sites) (Tables 4-18). Beyond those wetland associated species, 13 species were recorded that are deemed to be uncommon in the landscape (Table 19). (All butterfly taxonomy follows The Butterflies of Iowa [Schlicht, Downey and Nekola 2007]).

It was apparent early in the study that certain areas were “hot spots” of diversity for some of the more conservative species (Figures 1 and 2). These areas and the locations of more conservative species have been identified in the site maps (Figures 1-15).

Site Descriptions

Badger Creek Mitigation

Location: T 77N, R 25W, Sec 32 NE

Age: 6 years

Size: 137 acres

Wetland: 60 acres

Type: Reconstruction

Species: 43

Total butterflies: 1129

Shannon diversity index: 2.745

Shannon diversity index ranking among sites: 1st

The Badger Creek wetland site proved to be the study’s best performer. Both its number of species (43) and total number of butterflies recorded (1129) were well above the numbers recorded at any other site. Not surprisingly, its Shannon diversity index was also the highest of the 15 sites.

Of particular note for Lepidoptera species were Horace’s duskywing (*Erynnis horatius* Scudder & Burgess) (2 individuals), wild indigo duskywing (*Erynnis baptisiae* Forbes) (23), dion skipper (2), gray copper (140), bronze copper (13), regal fritillary (40), gorgone checkerspot (*Chlosyne gorgone* Hubner) (1), and silvery checkerspot (*Chlosyne nycteis* Doubleday & Hewitson) (4). Sizeable populations of several of these species are possible at this site for a number of reasons, including the presence of host plants (e.g., wild indigo duskywing uses wild indigo (*Baptisia bracteata* Muhl.), which is present at the site), the size of the site (at 137 acres, it is the largest site in our sample), and the

presence of nearby suitable lepidopteran habitats and riparian corridors from which colonization of Badger Creek can occur.

As stated, the site holds an impressive population of gray copper as well as a viable population of bronze copper, both wetland species. The presence of dion skipper is noteworthy since this species is an indicator of good wetland conditions. The high number of regal fritillaries, though it is normally found in quality prairie sites, indicates the presence of its host plants, violets, and a habitat suitable for this state-listed special concern species. Some of the hot spots for this site included the north and west sides of the westernmost pond.

The attention given to this site by management is evident by the variety and size of native species plantings now found at Badger Creek. We suggest that the demonstrated success of this site for Lepidoptera warrants analysis and emulation for the creation of future wetland mitigation sites. The richness at this site demonstrates the need for thoughtful management.

Boevers Mitigation

Location: T 92N, R 11W, Sec 32 SW, NW

Age: 1 year

Size: 18 acres

Wetland: 4 acres

Type: Constructed

Species: 17

Total butterflies: 128

Shannon diversity index: 2.116

Shannon diversity index ranking among sites: 13th

The Boevers site proved to be a poor performer. Its number of species (17) ranks next to the bottom among all sites, and the number of butterflies (128) was easily the lowest number. The Shannon diversity index for this site was 2.116, ranking it next to bottom.

The site suffers from a number of factors, including its small size, lack of diversity of forbs, and ineffectiveness of the wetland component, which, diminutive from the onset, virtually dried up early in the study year. We note that this site is also, with South Point (which has 30 species), only one year of age, and some plantings may not yet be producing aboveground presence.

Notable lepidoptera species at this site included bronze copper (3), meadow fritillary (*Boloria bellona* Fabricius) (2), and eyed brown (1). The bronze copper and especially the eyed brown are wetland species, as is the meadow fritillary, though to a lesser degree. These species are colonizing Boevers from the riparian habitats to the east and southeast of the site. For the eyed brown (the best wetland indicator species found at this site) to establish a viable population, the site must maintain sufficient water to permanently support sedges, its food plant. The hot spot for this site – if it can be designated – was along the north-central portion of Boevers near the small east-west waterway.

Brush Creek Mitigation

Location: T 78N, R 20W, Sec. 35 SE

Age: 8 years

Size: 104 acres

Wetland: 16 acres

Type: Reconstruction

Species: 34

Total butterflies: 732

Shannon diversity index: 2.325

Shannon diversity index ranking among sites: 9th

At eight years of age, Brush Creek and Mink Creek are the oldest non-original sites in the study sample. Given that time span, we would expect that the site might yield both a substantial numbers of species and total count of butterflies and skippers. The number of species at Brush Creek, 34, ranked second only to Badger Creek, while three other sites produced more individuals. The Shannon diversity index was 9th among the 15 sites studied.

This site is composed of two parcels separated by a four-lane divided highway. The north portion is in relatively close proximity to the city of Monroe's sewage treatment facility, and indeed discharge from that facility enters the watershed of this site.

Lepidoptera species we deemed noteworthy here included Horace's duskywing (2), wild indigo duskywing (1), dion skipper (2), gray copper (6), bronze copper (5), gorgone checkerspot (5), and silvery checkerspot (1). As mentioned above, the dion skipper is an indicator of quality wetland. Similarly, gray copper and bronze copper are to a somewhat lesser degree also good wetland species. Notable hot spots for the north portion of Brush Creek included the east side of the wetland. For the southern portion of the site, hot spots included along the northeast edge of the water, on the dike at the south, and along the west-central and northwest edges of the water.

Dike Mitigation

Location: T 88N, R 15W, Sec. 6 SW

Age: 7 years

Size: 48 acres

Wetland: 12 acres

Type: Constructed

Species: 16

Total butterflies: 513

Shannon diversity index: 2.264

Shannon diversity index ranking among sites: 10th

Despite its age, Dike produced the smallest number of species, 16, of any site. Its total count of butterflies ranks it in the middle of the study sites, while its Shannon rank is 10th.

The Dike site is impaired by the presence of extensive crops fields, with excessive periodic runoff, to its west and south, and by a four-lane divided highway to its north. To the east lie recreational areas of meager diversity. This site lacks nearby woodlands, meadows, or prairies from which colonization of the site might otherwise occur.

The only species of note at Dike was the bronze copper, which favors wet areas such as marshes and wet meadows. Its host food plants include various docks. The hot spot for this site was at the north and northwest areas of the wetland.

Doolittle Prairie State Preserve Prairie

Location: T 85 N, R 24W, Sec 25 NE

Age: original

Size: 24 acres

Wetland: 14 acres

Type: Original

Species: 23

Total butterflies: 382

Shannon diversity index: 2.023

Shannon diversity index ranking among sites: 14th

Despite being a “reference” site, Doolittle Prairie State Preserve Prairie ranked 10th in the number of species, and 11th in total individuals counted. Its Shannon diversity index ranked next to last among the sites.

Doolittle Prairie State Preserve is constrained by a variety of factors, including its relatively small size, its isolation from other natural areas (it is bordered on all sides by crop fields), the likely drift of herbicides/pesticides/fertilizers applied on adjacent fields, and possibly the effects of extensive fire management on the site. According to *The Guide to Iowa's State Preserves* (Herzberg and Pearson 2001), the northern 15 acres of Doolittle Prairie State Preserve Prairie was never plowed or grazed, while the southern portion had a history of grazing prior to acquisition in 1979. It would have been prescient at that time to have had a season-long lepidopteran (and other faunal) surveys conducted to determine what species were present when the property was acquired, and to have tailored management to assure the long-term viability of those species.

Notable species here include dion skipper (2), which we regard as an important indicator of a quality wetland. The site also holds a population of bronze copper (8), another wetland species. Three other species deserve mention: Aphrodite fritillary (*Speyeria aphrodite* Fabricius) (1) and regal fritillary (3) are both good-quality prairie species (the latter species is a special concern species in Iowa), and Reakirt's blue (*Hemiargus isola* Reakirt) (1) is a rather rare species whose host plants include legumes; it may be encountered in old fields and prairies. Hot spots include the north-central portion of the site along with the edges of wet potholes.

Engeldinger Marsh

Location: T 80 N, R 22W, Sec. 1 NE

Age: --
Size: 48 acres
Wetland: 17 acres
Type: Original
Species: 26
Total butterflies: 260
Shannon diversity index: 2.695
Shannon diversity index ranking among sites: 2nd

Despite having the next-to-lowest total count of butterflies, Engeldinger ranked 7th in total species and was 2nd highest in Shannon diversity index.

This site is essentially an island surrounded by non-native vegetation. The character of the vegetation around the circumference of the marsh/pond distinguishes it from that which we find around reconstructed or newly constructed mitigation wetlands: traversing the site is quite difficult due to the extreme unevenness of the boggy, quaking soil. One might expect to find rare species of flora and fauna at such a site, and such was the case for some of our lepidopteran species.

Among the notable wetland-indicative species were dion skipper (5), black dash (1), and the two-spotted skipper (1). All represent skipper species one finds at high-quality wetlands. We also located the wetland species gray copper (3), bronze copper (16), and meadow fritillary (3). Hot spots include much of the circumference of the pond, and especially the north, northwest, and northeast portions thereof.

Grooms Mitigation
Location: T 71N, R 14W, Sec. 10 NW
Age: 1 year
Size: 15 acres
Wetland: 6 acres
Type: Reconstruction
Species: 24
Total butterflies: 556
Shannon diversity index: 2.335
Shannon diversity index ranking among sites: 8th

Grooms ranked 9th in number of species, 6th in total count, and 8th in Shannon diversity index.

Grooms is bordered by cropland to the north, while a small stream with woods lying proximally to its south. Little opportunity exists for colonization of this site for wetland obligate species other than through the small riparian corridor. Since the site is essentially new, expectations should not yet be high for quality wetland species. Moreover, the “wetland” portion of the site (in the southeast corner) becomes essentially a mud puddle as the season progresses, and provides, for practical purposes, no habitat for wetland obligate species.

Nonetheless, we did locate two species that utilize wetlands: bronze copper (13) and meadow fritillary (2). These species may have their origin from the stream and its associated habitats that are located along the southern edge of the mitigation site. The hot spot, if it can be called that for this site, is along the southern portions of Grooms.

Hay-Buhr Area

Location: T 92N, R11W, Sec. 19-20

Age: --

Size: 115 acres

Wetland: 97 acres

Type: Original

Species: 21

Total butterflies: 470

Shannon diversity index: 2.179

Shannon diversity index ranking among sites: 11th

The 21 species located at this site rank 12th among the 15 sites studied; the 470 individual butterflies rank 9th among the sites. The Shannon diversity index ranking was 11th.

This is a large, and in many ways, a challenging site to survey. Walking around the site becomes both difficult and treacherous due to the unevenness of the ground and the thickness and height of the wetland grasses. Colonization to the site can occur from lands both to the north and west.

The site yielded two quality wetland skippers, dion skipper (4) and black dash (6). bronze copper (10), another wetland species is also present, along with silver-bordered fritillary (*Boloria selene* Denis & Schliiffermuller) (3) and meadow fritillary (2), which also inhabit areas near wetlands. The site also holds a large population of the wetland-obligate species eyed brown (91); this population was by far the largest for this species found at any of our sites. Hot spots include much of the periphery of the largest body of water as well as the north and northeast edges of the wetland (including the transect), where we found nearly all of the aforementioned species.

Jarvis Mitigation

Location: T 71N, R 6W, Sec. 6 SW

Age: 2 years

Size: 70 acres

Wetland: 45 acres

Type: Reconstruction

Species: 31

Total butterflies: 1476

Shannon diversity index: 2.613

Shannon diversity index ranking among sites: 4th

With 31 species, Jarvis ranks 4th among the 15 sites. Its ranks midway with total count of butterflies, and is 4th in Shannon diversity index.

Given the general condition of the wetland mitigation site, Jarvis ranks surprisingly high in number of species. The site is nominally divided into two sizeable portions, which are bisected by an elevated railroad right-of-way. The wetland area never reached more than half a hectare during our time on site. Typically it consisted of very shallow water confined to the northeasterly portion of the site. Colonization may occur from areas to the west and south of this site.

Despite the generally degraded appearance, Jarvis nonetheless is represented by wetland-associated species such as gray copper (2), bronze copper (15), and meadow fritillary (4). Hot spots include the northeasterly corners of both the northern and southern portions of the site.

Mink Creek Mitigation

Location: T 96N, R 16W, Sec. 27 SW

Age: 8 years

Size: 36 acres

Wetland: 8 acres

Type: Constructed

Species: 27

Total butterflies: 702

Shannon diversity index: 2.577

Shannon diversity index ranking among sites: 5th

Mink Creek ranks 6th in number of species and 5th in number of butterflies. Its Shannon diversity index rank is 5th among the 15 sites.

With Brush Creek, this site is the oldest of the reconstructed or constructed sites. It is relatively isolated from any nearby areas from which colonization of the site by various species could occur, with crop fields and a four-lane highway at its periphery. In addition, extensive erosion has occurred at the site, leaving countless long, narrow depressions running down the wetland's hillsides into the wet areas.

Nonetheless, Mink Creek harbors a number of noteworthy species, including long dash (1), dion skipper (1), black dash (3), gray copper (7), bronze copper (11), silver-bordered fritillary (3), meadow fritillary (2), and eyed brown (47). The first three species are all quality wetland indicator species, as is eyed brown. The other species are similarly associated with wet areas, though not necessarily high-quality wetlands. The site has several hot spots, including along the south edges of the wetland and the north-central edge of the wetland.

New Hampton Mitigation

Location: T 96N, R 13W, Sec. 1 NW

Age: 3 years

Size: 96 acres
Wetland: 10 acres
Type: Reconstruction
Species: 22
Total butterflies: 749
Shannon diversity index: 1.840
Shannon diversity index ranking among sites: 15th

New Hampton ranks last in Shannon diversity index, 11th in number of species, and 3rd in total numbers of individuals recorded (an anomaly due to a superabundance of one species, as is noted below).

One striking feature of this site is the vast coverage of timothy grass planted on the west side of the site. New Hampton is confined by a four-lane divided highway to its west and by a large off-site pond to its north. The town of New Hampton lies less than a mile to its east. Little in the way of remarkable habitat is in the vicinity of this site from which colonization to the New Hampton site can occur.

The total population count here is skewed by the abundant presence of the least skipper (395). No other site studied had populations approaching even half this number. Although least skipper is definitely a wetland-associated species, it is not uncommon in the landscape as a whole, and can be common to abundant when found. It cannot be regarded as indicative of a high quality wetland. We did locate four wetland species, however, including gray copper (1), bronze copper (28), meadow fritillary (1), and eyed brown (6). Hot spots include the western edge of the water, and along the east and northeast border of the pond.

Palisades Mitigation
Location: T 82N, R 5W, Sec. 7 SW
Age: 5 years
Size: 20 acres
Wetland: 4 acres
Type: Constructed
Species: 17
Total butterflies: 342
Shannon diversity index: 2.157
Shannon diversity index ranking among sites: 12th

Only one site in our sample had fewer species than Palisades. Total population counts ranked 12th, as did the Shannon diversity index.

Crops border this rather small site to the north and east. A four-lane highway borders Palisades to the south, and a homestead lies to the west. Palisades-Kepler State Park is located about a half-mile southwest of this wetland, but that park is primarily woodland, with no appreciable meadow, prairie, or wetland from which colonization might take place.

The only notable wetland species we located here was bronze copper (1). Some effort has been made at the site to plant a variety of native species; an abundance of nectar sources was frequently available during our surveys of the site. Hot spots here include along the south sides of both major ponds, and along the northwest edge of the westerly pond. During the survey year 2005, there was a severe drought in the area.

Pleasantville

Location: T 75N, R 21W, Sec. 10 E

Age: 3 years

Size: 13 acres

Wetland: 4 acres

Type: Reconstruction

Species: 30

Total butterflies: 398

Shannon diversity index: 2.517

Shannon diversity index ranking among sites: 7th

Despite its diminutive size, Pleasantville ranked 4th in total number of species. It ranks 10th in total population count, and 7th in Shannon diversity index.

Although bordered on its west by a highway, Pleasantville is situated along a riparian border to its south and east, and with some marginally wet habitat to its north.

This site contained two wetland-associated species, gray copper (8) and bronze copper (22). Another species of note – although not a wetland species – is silvery checkerspot (1). Hot spots here are found along the western edge of the water, the south edge of the wetland, and a sizeable area extending outward from the east edge of the water.

South Point Mitigation

Location: T 80N, R 22W, Sec. 2 SW

Age: 1 year

Size: 40 acres

Wetland: 10 acres

Type: Constructed

Species: 30

Total butterflies: 733

Shannon diversity index: 2.644

Shannon diversity index ranking among sites: 3rd

Despite being newly constructed, South Point's rank tied for 4th in number of species, and was 4th in total population counts. The Shannon diversity index was 3rd among all sites.

South Point benefits greatly from its site selection, with close proximity to quality wetland sites at its north and northwest. Some woodland to the north also provide habitat from which colonization can occur. On the other hand, crops are planted within a few

meters of the primary pond at its southwest edge, and herbicide/pesticide/fertilizer leaching or drift into the site seems likely, particularly since the crop land slopes toward the wetland.

Even at an age of one year, the site already exhibits wetland-associated species, including gray copper (8), bronze copper (29), and meadow fritillary (1). Three other notable (though non-wetland obligate) species located here are gorgone checkerspot (3), silvery checkerspot (2), and northern pearly-eye (*Enodia anthedon* Clark) (2); this last species, a typically woodland denizen, was located at the extreme northern portion of the site where it abuts woodland. Hot spots include along the edges of slopes of the site at the west and southwest, and the wet areas at the north-northeast portion of the site.

Wickiup Hill Mitigation

Location: T 84N, R 8W, Sec. 15 SW

Age: 6 years

Size: 48 acres

Wetland: 15 acres

Type: Reconstruction

Species: 25

Total butterflies: 341

Shannon diversity index: 2.540

Shannon diversity index ranking among sites: 6th

Wickiup Hill ranked in the middle of the sites for number of species, but was 13th in total count. Its Shannon rating was 6th.

The largest pond at this site dried up as the season wore on, but the wetland area at the north still retained some moisture. For a portion of the season the transect area was off limits due to introduced osprey, but adjacent areas were sampled by the research team. Colonization prospects for this wetland mitigation site include lands around the periphery of Wickiup; these areas have woodlands, river bottom habitat, and reconstructed prairie.

We did locate dion skipper (3), a good wetland indicator species, in the northern area of the wetland, which at this time is the highest quality portion of the site. Other wetland species included gray copper (9) and bronze copper (3). Hot spots include the aforementioned northern wetland area and just to the northeast of the large pond.

DISCUSSION

After finding the mitigation sites and defining their boundaries was accomplished, the site had to be explored to find the best areas for the repeated walk-throughs. Those routes needed to be associated with the wetland areas and yet represent the major plant communities of the entire site. Because these are wetlands the water levels varied through the season. Some routes chosen early in the season were later underwater and others were

left high and dry, away from standing water. We made every effort to make the survey repeatable.

Weather played a factor at some sites. Weather parameters were always met but combinations such as cloud cover with low temperatures and/or wind meant that some surveys had to be postponed beyond the 10-day plan.

The transects for the project were designed as large rectangular plots perpendicular to the wet areas. However, due to the nature of our flying insects, the surveyor moved through lineal transects, so that we do not count the same individual multiple times. Our transects crossed the larger plots at each site. GPS locations and time spent on each transect were recorded.

Three reference sites were used for comparisons to evaluate the mitigation sites. Two of these, Engeldinger Marsh and Hay-Buhr Area, were judged to be functioning comparison assemblages of species. While both are wetlands, their physical geography is completely different. Engeldinger Marsh is an upland isolated wetland, whereas the Hay-Buhr Area is a riparian floodplain marsh. The third, Doolittle Prairie State Preserve, came out near the bottom of the list for Shannon diversity index and species richness. It fails to meet most of our mitigation criteria (below) and the butterfly richness is likely damaged from years of extensive fire management.

From our experience with these wetland mitigation sites, the success of a site begins with appropriate site selection and site design. Success through time is contingent upon appropriate site management, which takes into account the findings of these surveys, and which directs actions toward maintaining and augmenting species diversity across all taxa. Management should include periodic floral and faunal surveys to evaluate the continuing viability of species richness as well as periodic review of the management practices to assure that species diversity is increasing across all taxa.

In evaluating both the mitigation sites and the reference sites, we compiled this list of factors that should be taken into account to insure success of mitigation sites. These factors include:

- ❖ Selection and development of sites that will maintain constant wetness.
- ❖ Selection of sites near habitats and corridors from which colonization of native species can occur.
- ❖ Size of site. Generally larger sites support greater diversity.
- ❖ Use of native plants during seeding.
- ❖ Diversity of plant species chosen for the site.
- ❖ Erosion prevention during construction.
- ❖ Control of invasive species.
- ❖ Periodic surveys to assess species richness to determine management success.
- ❖ Determination at time of site selection the existence of native diversity, with the goal of leaving those native areas intact.
- ❖ Diversified management appropriate to the viability of key species and to promote species richness.

LITERATURE CITED

- Herzberg, Ruth and John Pearson. 2001. The Guide to Iowa's State Preserves. University of Iowa Press, Iowa City, IA, USA.
- Pielou, E.C. 1977. Mathematical Ecology, John Wiley & Sons, Inc., New York, NY, USA. p.299-303.
- Pollard, Ernest. 1991. Monitoring Butterfly Numbers, Monitoring for Conservation and Ecology, Barrie Goldsmith Ed., Chapman and Hall, London.
- Pollard, E. and T.J. Yates. 1993. Monitoring Butterflies for Ecology and Conservation. Chapman and Hall, London.
- Schlicht, Dennis W., John C. Downey and Jeffery C. Nekola 2007. The Butterflies of Iowa. University of Iowa Press, Iowa City, IA. USA.

TABLES

- Table 1. Rankings of Conservatism and Wetland Affinity
- Table 2. Species List All Sites
- Table 3. Shannon Diversity Index Site Rankings
- Tables 4-18 Site Summaries
- Table 19. Uncommon Species

Table 1 – Rankings of Conservatism and Wetland Affinity

SKIPPERS	Family <u>Hesperiidae</u>	Wetland	
		<u>Conservatism</u>	<u>Affinity</u>
	Silver-spotted Skipper <u>Epargyreus clarus</u>	2	-1
	Horace's Duskywing <u>Erynnis horatius</u>	5	0
	Wild Indigo Duskywing <u>Erynnis baptisiae</u>	4	4
	Common Checkered-Skipper <u>Pyrgus communis</u>	2	3
	Common Sootywing <u>Pholisora catullus</u>	2	2
	Least Skipper <u>Ancyloxypha numitor</u>	2	-4
	European Skipper <u>Thymelicus lineola</u>	3	4
	Fiery Skipper <u>Hylephila phyleus</u>	6	1
	Sachem <u>Atalopedes campestris</u>	4	3
	Peck's Skipper <u>Polites peckius</u>	3	0
	Tawny-edged Skipper <u>Polites themistocles</u>	3	3
	Crossline Skipper <u>Polites origenes</u>	3	3
	Long Dash <u>Polites mystic</u>	4	-3
	Delaware Skipper <u>Anatrytone logan</u>	2	0
	Hobomok Skipper <u>Poanes hobomok</u>	3	-2
	Black Dash <u>Euphyes conspicua</u>	3	-4
	Dion Skipper <u>Euphyes dion</u>	4	-4
	Two-spotted Skipper <u>Euphyes bimacula</u>	5	-3

Dun Skipper <u>Euphyes vestris</u>	3	0
SWALLOWTAILS Family <u>Papilionidae</u>		
Black Swallowtail <u>Papilio polyxenes</u>	2	0
Eastern Tiger Swallowtail <u>Papilio glaucus</u>	2	2
Giant Swallowtail <u>Papilio cresphontes</u>	2	2
WHITES AND SULPHURS Family <u>Peiridae</u>		
Checkered White <u>Pontia protodice</u>	4	2
Cabbage White <u>Pieris rapae</u>	1	0
Clouded Sulphur <u>Colias philodice</u>	2	2
Orange Sulphur <u>Colias eurytheme</u>	2	2
Cloudless Sulphur <u>Phoebis sennae</u>	6	2
Little Yellow <u>Eurema lisa</u>	2	2
Dainty Sulphur <u>Nathalis iole</u>	4	2
GOSSAMER-WING BUTTERFLIES Family <u>Lycaenidae</u>		
Gray Copper <u>Lycaena dione</u>	3	-3
Bronze Copper <u>Lycaena hyllus</u>	2	-3
Coral Hairstreak <u>Satyrium titus</u>	3	3
Gray Hairstreak <u>Strymon melinus</u>	3	2
Eastern Tailed-Blue <u>Everes comyntas</u>	2	-1
Summer Azure <u>Celastrina neglecta</u>	2	2
Reakirt's Blue <u>Echinargus isola</u>	4	3
BRUSHFOOTED BUTTERFLIES Family <u>Nymphalidae</u>		
American Snout <u>Libytheana carinenta</u>	5	-1

Monarch <u>Danaus plexippus</u>	2	1
Variegated Fritillary <u>Euptoieta claudia</u>	4	2
Great Spangled Fritillary <u>Speyeria cybele</u>	2	2
Aphrodite Fritillary <u>Speyeria aphrodite</u>	4	2
Regal Fritillary <u>Speyeria idalia</u>	4	2
Silver-bordered Fritillary <u>Boloria selene</u>	3	-2
Meadow Fritillary <u>Boloria bellona</u>	2	-2
Gorgone Checkerspot <u>Chlosyne gorgone</u>	4	1
Silvery Checkerspot <u>Chlosyne nycteis</u>	5	2
Pearl Crescent <u>Phyciodes tharos</u>	2	0
Buckeye <u>Junonia coenia</u>	4	3
Question Mark <u>Polygonia interrogationis</u>	2	3
Eastern Comma <u>Polygonia comma</u>	2	3
Mourning Cloak <u>Nymphalis antiopa</u>	3	2
Red Admiral <u>Vanessa atalanta</u>	2	2
Painted Lady <u>Vanessa cardui</u>	2	3
American Lady <u>Vanessa virginiensis</u>	3	2
Red-spotted Purple <u>Limenitis arthemis astyanax</u>	2	2
Viceroy <u>Limenitis archippus</u>	2	-1
Hackberry Emperor <u>Asterocampa celtis</u>	3	4
Northern Pearly-eye <u>Enodia anthedon</u>	6	-2
Eyed Brown <u>Satyrodes eurydice</u>	3	-4
Little Wood-Satyr <u>Megisto cymela</u>	2	3

Names, numbers and order from;

Opler and Warren, 2003. Butterflies of North America. 2. Scientific Names for Butterfly Species of North America, north of Mexico. 82pp.

Brock and Kaufman, 2003. Butterflies of North America, Kaufman Focus Guides, 284pp.

Table 2 - Species List All Sites

Common Name	Scientific Name	Authority	Grooms	South Point	Pleasantville	New Hampton	Jarvis	Palisades	Wickiup	Boevers	Badger Creek	Mink Creek	Brush Creek	Dike	Engeldinger	Hay-Buhr	Doolittle	Total Count
Silver-spotted Skipper	Epargyreus clarus	Cramer			2		1	1	3		16		14		1		1	39
Horace's Duskywing	Erynnis horatius	Scudder and Burgess									2		2					4
Wild Indigo Duskywing	Erynnis baptisiae	Forbes									23		1					24
Checkered Skipper	Pyrgus communis	Grote			2						1		1		3			7
Common Sootywing	Pholisora catullus	Fabricius	2	8	3	1	21			2	6	9	3		6	4	2	67
Least Skipperling	Ancyloxypha numitor	Fabricius	11	97	46	395	17	34	23	7	16	73	47	55	34	157	3	1015
European Skipper	Thymelicus lineola	Ochsenheimer	9		24	12		58					4					107
Fiery Skipper	Hylephila phyleus	Drury			1													1
Peck's Skipper	Polites coras	Kirby	5	13	5		1				5	2	6					37
Tawny-edged Skipper	Polites themistocles	Latreille	1		1		1				8							11
Crossline Skipper	Polites origenes	Fabricius									3							3
Long Dash	Polites mystic	Edwards										1						1
Sachem	Atalopedes campestris	Boisduval									1							1
Delaware Skipper	Anatrytone logan	Edwards	10	46	9	4	10		1		39	12	45		3			179
Hobomok Skipper	Poanes hobomok	Harris					1				3							4
Dion Skipper	Euphyes dion	Edwards							3		2	1	2		5	4	2	19
Black Dash	Euphyes conspicua	Edwards										3			1	6		10
Two-spotted Skipper	Euphyes bimacula	Grote and Robinson													1			1
Dun Skipper	Euphyes vestris	Boisduval					1				4							5
Black Swallowtail	Papilio polyxenes	Fabricius	14	4	6	21	3	5	5	1	28	6	48	15	13	2	31	202
Giant Swallowtail	Papilio cresphontes	Cramer			3		1		1		2							7
Tiger Swallowtail	Paplio glaucus	Linnaeus	1	1	2		5	1	4	2	7	4	5	3	1		2	38
Checkered White	Pontia protodice	Boisduval and LeConte		1							1							2
Cabbage White	Pieris rapae	Linnaeus	127	51	8	77	64	19	46	46	10	55	26	72	8	20	3	632
Clouded Sulphur	Colias philodice	Godart	100	140	39	5	27	20	62	5	58	23	35	38	34	2	11	599
Orange Sulphur	Colias eurytheme	Boisduval	61	65	18	10	24	38	16	2	88	58	17	29	14	7	45	492
Cloudless Sulphur	Phoebis sennae	Linnaeus					5		11		5	1	1					23
Little Yellow	Eurema lisa	Boisduval and LeConte	5	20	1		14		1		10			5	2			58
Dainty Sulphur	Nathalis iole	Boisduval		1														1
Gray Copper	Lycaena dione	Scudder		8	8	1	2		9		140	7	6		3			184
Bronze Copper	Lycaena hyllus	Cramer	13	29	22	28	15	1	3	3	13	11	5	6	16	10	8	183
Coral Hairstreak	Satyrium titus	Fabricius									3		2		1			6
Gray Hairstreak	Strymon melinus	Hubner							1		3		2				1	7
Reakirt's Blue	Hemiargus isola	Reakirt															1	1
Eastern Tailed-Blue	Everes comyntas	Godart	75	99	21	26	21	48	10	23	300	137	265	106	29	7	82	1249
Summer Azure	Celastrina neglecta	Edwards	7	6	1	26	3	2	7	1	8	16	8	24		46	1	156
American Snout	Libytheana carinenta	Cramer						1			1							2
Variegated Fritillary	Euptoieta claudia	Cramer											1	1			1	3
Great Spangled	Speyeria cybele	Fabricius		4	5		1		5	1	13		2			2		33
Aphrodite Fritillary	Speyeria aphrodite	Fabricius															1	1
Regal Fritillary	Speyeria idalia	Drury									40						3	43
Silver-bordered	Boloria selene	Denis and Schiffermuller										3				3		6
Meadow Fritillary	Boloria bellona	Fabricius	2	1		1	4			2		2			3	2		17
Gorgone Checkerspot	Chlosyne gorgone	Hubner		3							1		5					9
Silvery Checkerspot	Chlosyne nycteis	Doubleday and Hewitson		2	1						4		1					8
Pearly Crescentspot	Phyciodes tharos	Drury	66	112	123	19	64	90	44	10	84	83	129	78	33	35	27	997
Question Mark	Polygonia interrogat.	Fabricius		1	1		2		3		10	3	6					26
Eastern Comma	Polygonia comma	Harris							1		2		2			1		6
Mourning Cloak	Nymphalis antiopa	Linnaeus									2				2			4

Table 2 - Species List All Sites

American Lady	Vanessa virginiensis	Drury		6		2												8
Painted Lady	Vanessa cardui	Linnaeus	16	30	13	12	15	9						1	15	18	3	132
Red Admiral	Vanessa atalanta	Linnaeus		11	4	5	16			1	1	3	3		2	1	2	49
Buckeye	Junonia coenia	Hubner	1	1	1		2		2						1			8
Red-spotted Purple	Limenitis a. astyanax	Fabricius	1			1		1			1	2		1				7
Viceroy	Limenitis archippus	Cramer	7	46	1	21	11	9	34	11	54	74	10	17	7	17	1	320
Hackberry Butterfly	Asterocampa celtis	Boisduval and LeConte	1				5		1									7
Northern Pearly-Eye	Enodia anthedon	Clark		2														2
Eyed Brown	Satyrodes eurydice	Linnaeus				6				1		47				91		145
Little Wood Satyr	Megisto cymela	Cramer											2					2
Wood Nymph	Cercyonis pegala	Fabricius	1	1	2	2	2				37	17	8				13	83
Monarch	Danaus plexippus	Linnaeus	20	39	25	74	117	5	45	10	74	49	18	62	22	35	138	733
[61 species -- all sites]	Total Species per Site		24	30	30	22	31	17	25	17	43	27	34	16	26	21	23	
	Total Count per Site		556	848	398	749	476	342	341	128	1129	702	732	513	260	470	382	8026

Table 3 – Shannon Diversity Index Site Rankings

<u>Site</u>	<u>Shannon Div. Index</u>	<u>Species</u>	<u>Age</u>	<u>Size</u>	<u>Wetland Acres</u>	<u>Wet ratio</u>	<u>Type</u>	<u>Assoc.</u>
Badger Creek	2.745	43	6	137	60	44%	Restor.	River Bottom
Engeldinger	2.695	26	Orig	47.6	17.2	36	Natural	Isolated
South Point	2.644	30	1	40	10	25	Created	Pr. Old Field
Jarvis	2.613	31	2	70	45	64	Restor.	River Bottom
Mink Creek	2.577	27	8	36	8	22	Created	Isolated
Wickiup	2.540	25	6	48	15	31	Restor.	River Bottom
Pleasantville	2.517	30	3	13	4	31	Restor.	River Bottom
Grooms	2.335	24	1	15	6	40	Restor.	River Bottom
Brush Creek	2.325	34	8	104	16	15	Restor.	River Bottom
Dike	2.264	16	7	48	12	25	Created	Isolated
Hay-Buhr	2.179	21	Orig	115	97	84	Natural	River Bottom
Palisades	2.157	17	5	20	4	20	Created	Isolated
Boevers	2.116	17	1	18	4	22	Created	River Bottom
Doolittle	2.023	23	Orig	24	14	58	Natural	Isolated
New Hampton	1.840	22	3	96	10	11	Restor.	Isolated

Table 4 - Grooms

Common Name	Scientific Name	8-May	17-May	30-May	11-Jun	20-Jun	1-Jul	11-Jul	20-Jul	1-Aug	14-Aug	23-Aug	3-Sep	Total
Common Sootywing	Pholisora catullus			1						1				2
Least Skipperling	Ancyloxypha numitor			4	5	1					1			11
European Skipper	Thymelicus lineola					9								9
Peck's Skipper	Polites coras									4	1			5
Tawny-edged Skipper	Polites themistocles				1									1
Delaware Skipper	Anatrytone logan				6		1			1		2		10
Black Swallowtail	Papilio polyxenes					1		2		1	3	4	3	14
Tiger Swallowtail	Papilio glaucus									1				1
Cabbage White	Pieris rapae				20	7	3	17	7	13	45	7	8	127
Clouded Sulphur	Colias philodice			2	8	7	1	4	9	3	9	15	42	100
Orange Sulphur	Colias eurytheme			2	2	2	2	1	6	4	12	7	23	61
Little Yellow	Eurema lisa							1		2			2	5
Bronze Copper	Lycaena hyllus			1	1				2			1	8	13
Eastern Tailed-Blue	Everes comyntas		2	2	4	1	1	3	7	37	10	5	3	75
Summer Azure	Celastrina neglecta				4	1			2					7
Meadow Fritillary	Boloria bellona							1	1					2
Pearly Crescentspot	Phyciodes tharos		1				12	4	1	3	7	16	22	66
Painted Lady	Vanessa cardui							2			2	11	1	16
Buckeye	Junonia coenia											1		1
Red-spotted Purple	Limenitis a. astyanax									1				1
Viceroy	Limenitis archippus										1		6	7
Hackberry Butterfly	Asterocampa celtis									1				1
Wood Nymph	Cercyonis pegala											1		1
Monarch	Danaus plexippus			2				1	2	2	6	5	2	20
	Total Species	0	2	7	9	8	6	10	9	14	11	12	11	
	Total Individuals	0	3	14	51	29	20	36	37	74	97	75	120	556

Table 5 - South Point

[illegible]

Table 6 - Pleasantville

[illegible]

Table 7 - New Hampton

[illegible]

Table 8 - Jarvis

[illegible]

Table 9 - Palisades

[illegible]

Table 11 - Boevers

[illegible]

Table 12 - Badger Creek

Common Name	Scientific Name	7-May	17-May	26-May	7-Jun	19-Jun	29-Jun	7-Jul	18-Jul	28-Jul	7-Aug	16-Aug	27-Aug	6-Sep
Silver-spotted Skipper	Epargyreus clarus		1	1		2					1		1	10
Horace's Duskywing	Erynnis horatius							2						
Wild Indigo Duskywg	Erynnis baptisiae			1							9	10	2	1
Checkered Skipper	Pyrgus communis													1
Common Sootywing	Pholisora catullus										4	2		
Least Skipperling	Ancyloxypha numitor				7	1			1		5		2	
Peck's Skipper	Polites coras			1	4									
Tawny-edged Skipper	Polites themistocles			1	4							1	1	1
Crossline Skipper	Polites origenes											1	2	
Sachem	Atalopedes campestri													1
Delaware Skipper	Anatrytone logan					10					17	12		
Hobomok Skipper	Poanes hobomok			1	2									
Dion Skipper	Euphyes dion						2							
Dun Skipper	Euphyes vestris										1	2		1
Black Swallowtail	Papilio polyxenes	1	1	3				1		1	7	5	3	6
Giant Swallowtail	Papilio cressphontes									1	1			
Tiger Swallowtail	Papilio glaucus	1		2	2						1	1		
Checkered White	Pontia protodice											1		
Cabbage White	Pieris rapae				2	2		1	2	1	2			
Clouded Sulphur	Colias philodice	2	2			1	1		4	7	6	12	3	20
Orange Sulphur	Colias eurytheme					3	1	2	4	4	11	16	6	41
Cloudless Sulphur	Phoebis sennae								1		1	1		2
Little Yellow	Eurema lisa				1				1		2	3	1	2
Gray Copper	Lycaena dione				4	73	43	20						
Bronze Copper	Lycaena hyllus			6	5								1	1
Coral Hairstreak	Satyrium titus						2	1						
Gray Hairstreak	Strymon melinus										1		2	
Eastern Tailed-Blue	Everes comyntas	4	2	6	12	8	16	27	18	36	65	40	43	23
Summer Azure	Celastrina neglecta				7								1	
American Snout	Libytheana carinenta													1
Great Spangled Frit.	Speyeria cybele					2	5		3		1	1	1	
Regal Fritillary	Speyeria idalia					17	11	3	2	3	1	1		2
Gorgone Checkerspot	Charidryas gorgone												1	
Silvery Checkerspot	Chlosyne nycteis				2					1	1			
Pearly Crescentspot	Phyciodes tharos	12	4	1		3	4	9	4	6	7	15	8	11

Table 12 - Badger Creek

[illegible]

Table 13 - Mink Creek

[illegible]

Table 14 - Brush Creek

[illegible]

Table 15 - Dike

[illegible]

Table 16 - Engeldinger Marsh

[illegible]

Table 17 - Hay-Buhr Area

Common Name	Scientific Name	10-May	20-May	31-May	10-Jun	20-Jun	30-Jun	10-Jul	22-Jul	4-Aug	12-Aug	22-Aug	2-Sep	Total
Common Sootywing	Pholisora catullus									1	2	1		4
Least Skipperling	Ancyloxypha numitor				11	7		1	2	60	44	28	4	157
Dion Skipper	Euphyes dion						1	2	1					4
Blash Dash	Euphyes conspicua							6						6
Black Swallowtail	Papilio polyxenes												2	2
Cabbage White	Pieris rapae							2	4	1	7		6	20
Clouded Sulphur	Colias philodice					1			1					2
Orange Sulphur	Colias eurytheme				1		1				3		2	7
Bronze Copper	Lycaena hyllus				4	3			1		2			10
Eastern Tailed-Blue	Everes comyntas								2	2	2		1	7
Summer Azure	Celastrina neglecta				34	5		2	2	2			1	46
Great Spangled Frit.	Speyeria cybele						1	1						2
Silver-bordered Frit.	Boloria selene							1	1			1		3
Meadow Fritillary	Boloria bellona										1	1		2
Pearly Crescentspot	Phyciodes tharos			1	1			3	5	6	8	4	7	35
Eastern Comma	Polygonia comma								1					1
Painted Lady	Vanessa cardui								1	2	13		2	18
Red Admiral	Vanessa atalanta							1						1
Viceroy	Limenitis archippus					1			2	5	5	3	1	17
Eyed Brown	Satyroides eurydice						33	42	14	2				91
Monarch	Danaus plexippus								5	3	3	2	22	35
	Total Species	0	0	1	5	5	4	10	14	10	11	7	10	
	Total Individuals	0	0	1	51	17	36	61	42	84	90	40	48	470

Table 18 - Doolittle Prairie

[illegible]

Table 19 - Uncommon Species Data

<u>Common Name</u>	<u>Wetland Affinity</u>	<u>Conservatism</u>	<u>Total Count</u>	<u>Total Sites</u>	<u>Which Sites*</u>
Horace's Duskywing	0	5	4	2	Ba, Br
Long Dash	-3	4	1	1	Mi
Dion Skipper	-4	4	19	7	Ba, Br, Do, Mi, Wi, En, Ha
Black Dash	-4	3	10	3	Mi, En, Ha
Checkered White	+2	4	2	2	Ba, So
Reakirt's Blue	+3	4	1	1	Do
American Snout	-1	5	2	2	Ba, Pa
Aphrodite Fritillary	+2	4	1	1	Do
Regal Fritillary	+2	4	43	2	Ba, Do
Silver-bordered Fritillary	-2	3	6	2	Mi, Ha
Gorgone Checkerspot	+1	4	9	3	Ba, Br, So
Silvery Checkerspot	+2	5	8	4	Ba, Br, Pl, So
Northern Pearly-Eye	-2	6	2	1	So

* Site abbreviations:

Ba = Badger Creek

Br = Brush Creek

Do = Doolittle

En = Engeldinger

Ha = Hay-Buhr

Mi = Mink Creek

Pa = Palisades

Pl = Pleasantville

So = South Point

Wi = Wickiup

Figure 1

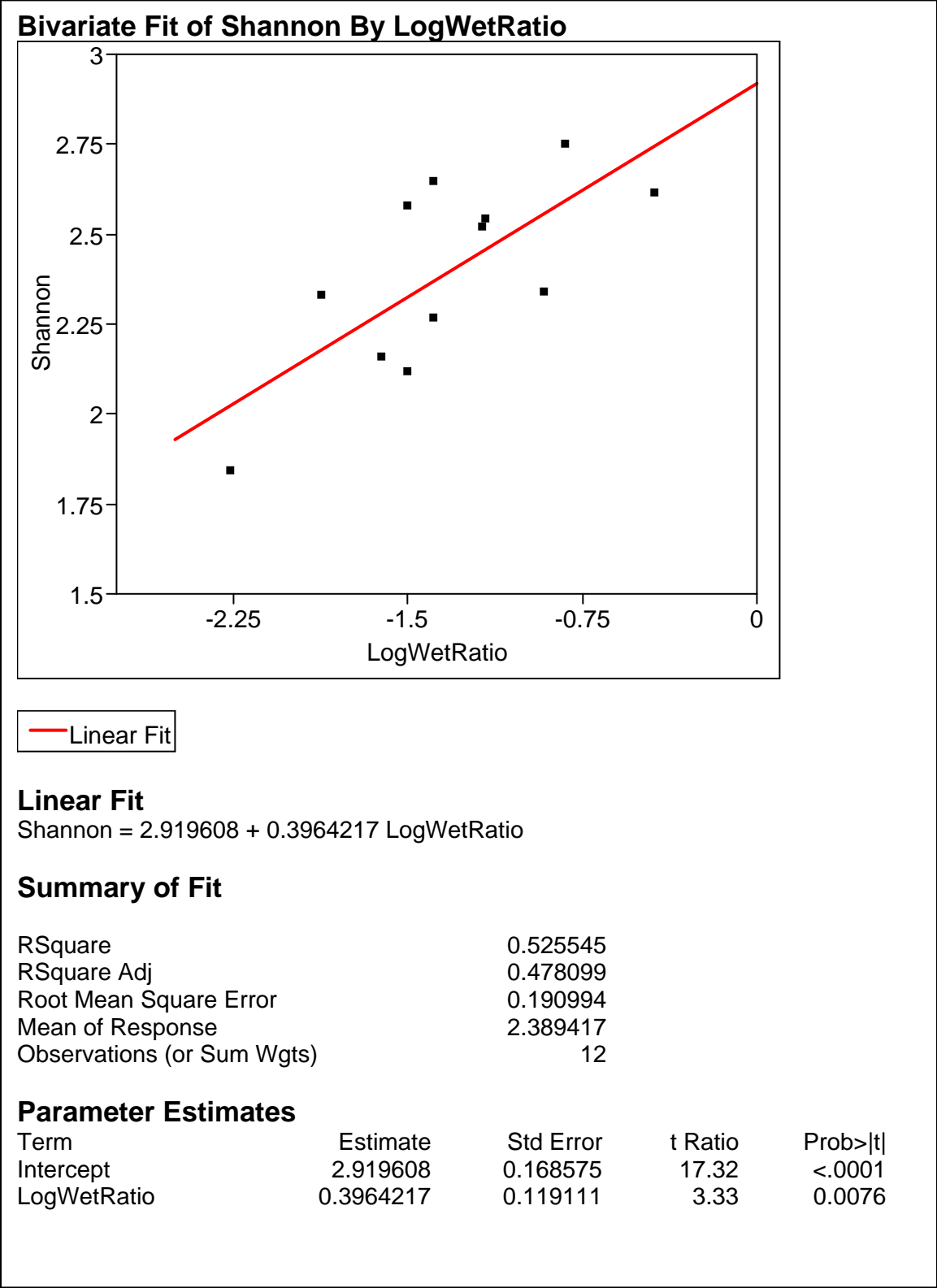


Fig 2 Lepidoptera All Sites

Site No	Site Name	Site C/Q	Mean Species C/Q	Wetland Affinity		Species Richness	Shannon Index	
				WA Average	% Species =< 0		N Individuals	Index
1	Grooms	11.18	2.19	0.96	42	26	1100	1.07
2	South Point	14.06	2.57	0.63	43	30	1678	1.15
3	Pleasantville	13.51	2.47	0.93	40	30	796	1.09
4	New Hampton	10.02	2.14	0.18	55	22	1488	0.79
5	Jarvis	13.11	2.35	0.65	48	31	970	1.14
6	Palisades	8.97	2.18	0.41	53	17	684	0.94
7	Wickiup Hill	12.16	2.38	0.65	42	26	341	1.10
8	Boevers	8.25	2.00	-0.06	53	17	122	0.92
9	Badger Creek	18.15	2.77	0.91	40	43	1102	1.17
10	Mink Creek	12.70	2.44	-0.44	63	27	678	1.11
11	Brush Creek	15.43	2.65	0.88	41	34	686	1.00
12	Dike	8.25	2.06	0.56	44	16	482	0.97
13	Engeldinger Marsh	12.36	2.42	0.04	54	26	520	1.17
14	Hay-Buhr Area	10.63	2.22	-0.09	57	23	1020	0.98
15	Doolittle Prairie	11.68	2.43	0.57	43	23	375	0.87
Average		12.03	2.35	0.45	47.87	26.07	802.80	1.03

N Sites GE Average

8

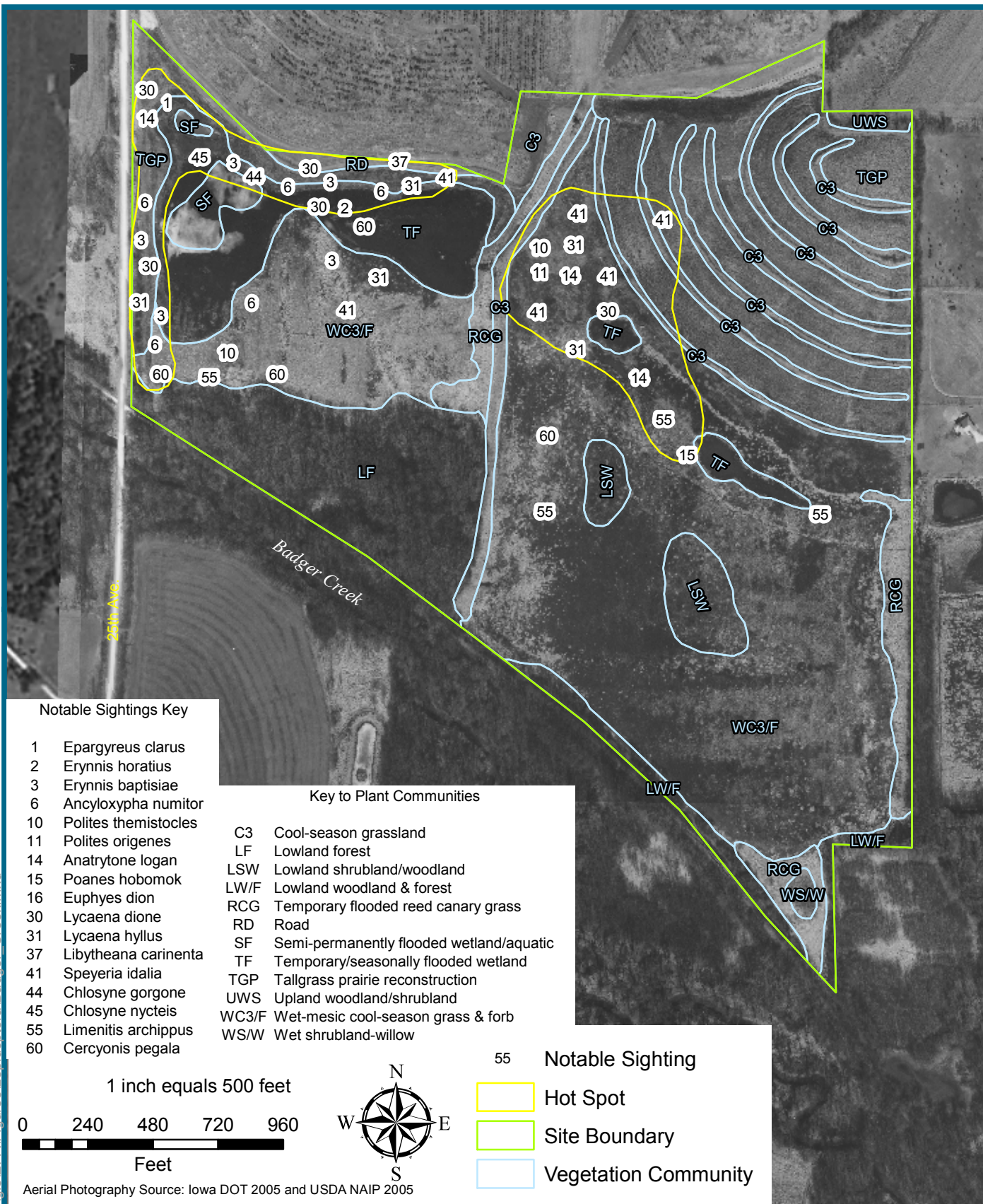
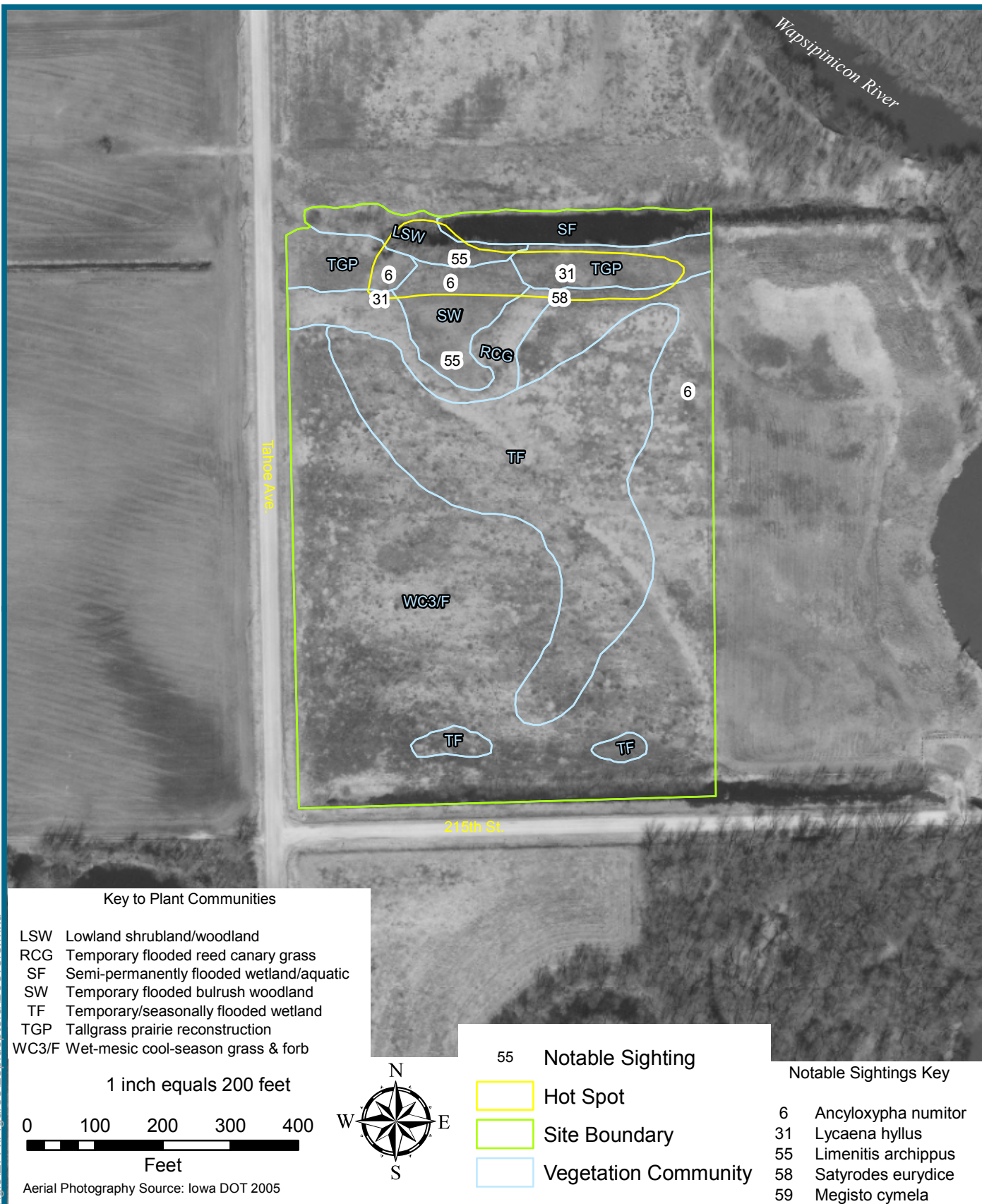


Figure 3
Site No. 9 - Badger Creek

L:\work\project\45593\gis\EPA\Figures\lepidoptera\Boevers.mxd

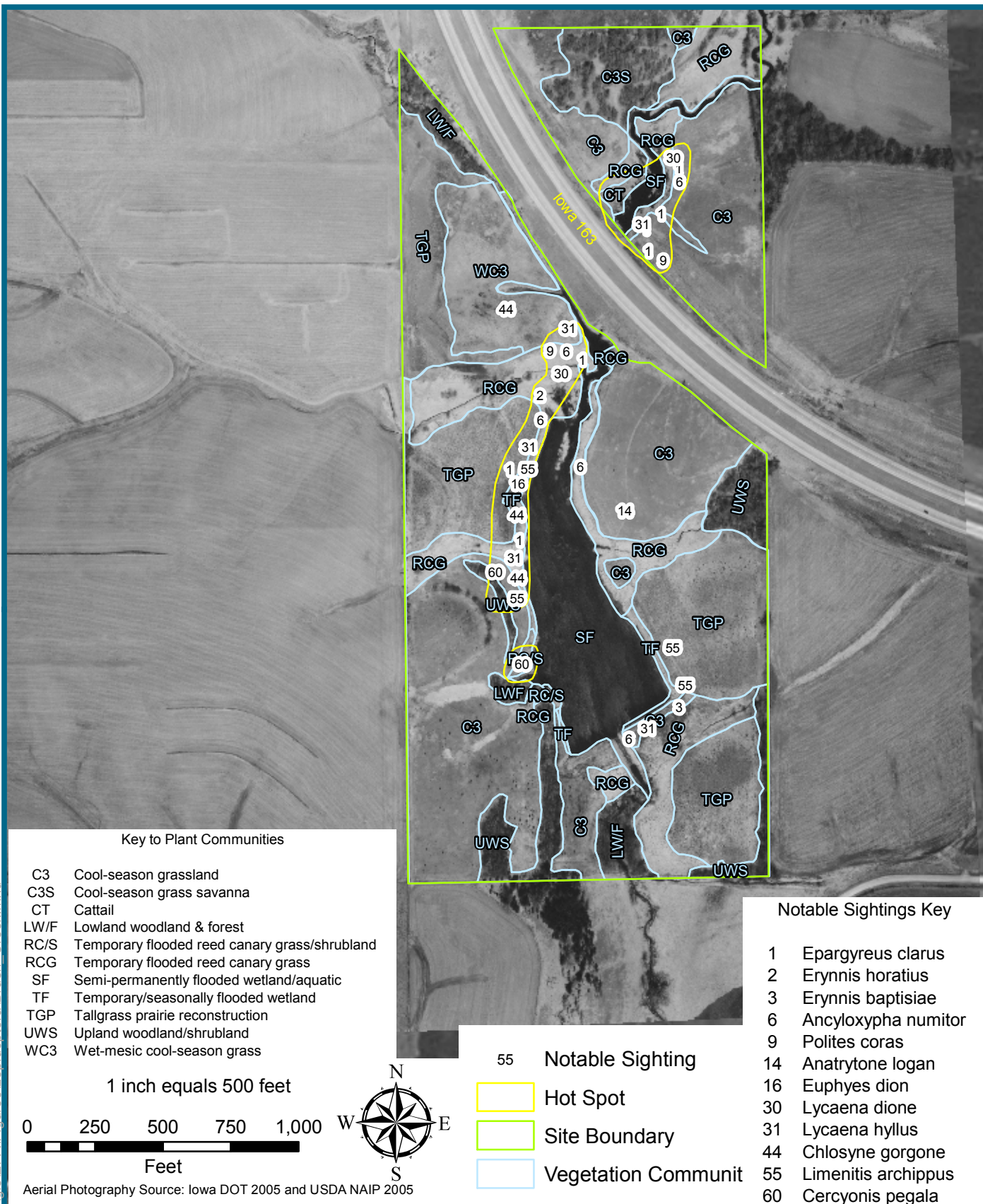


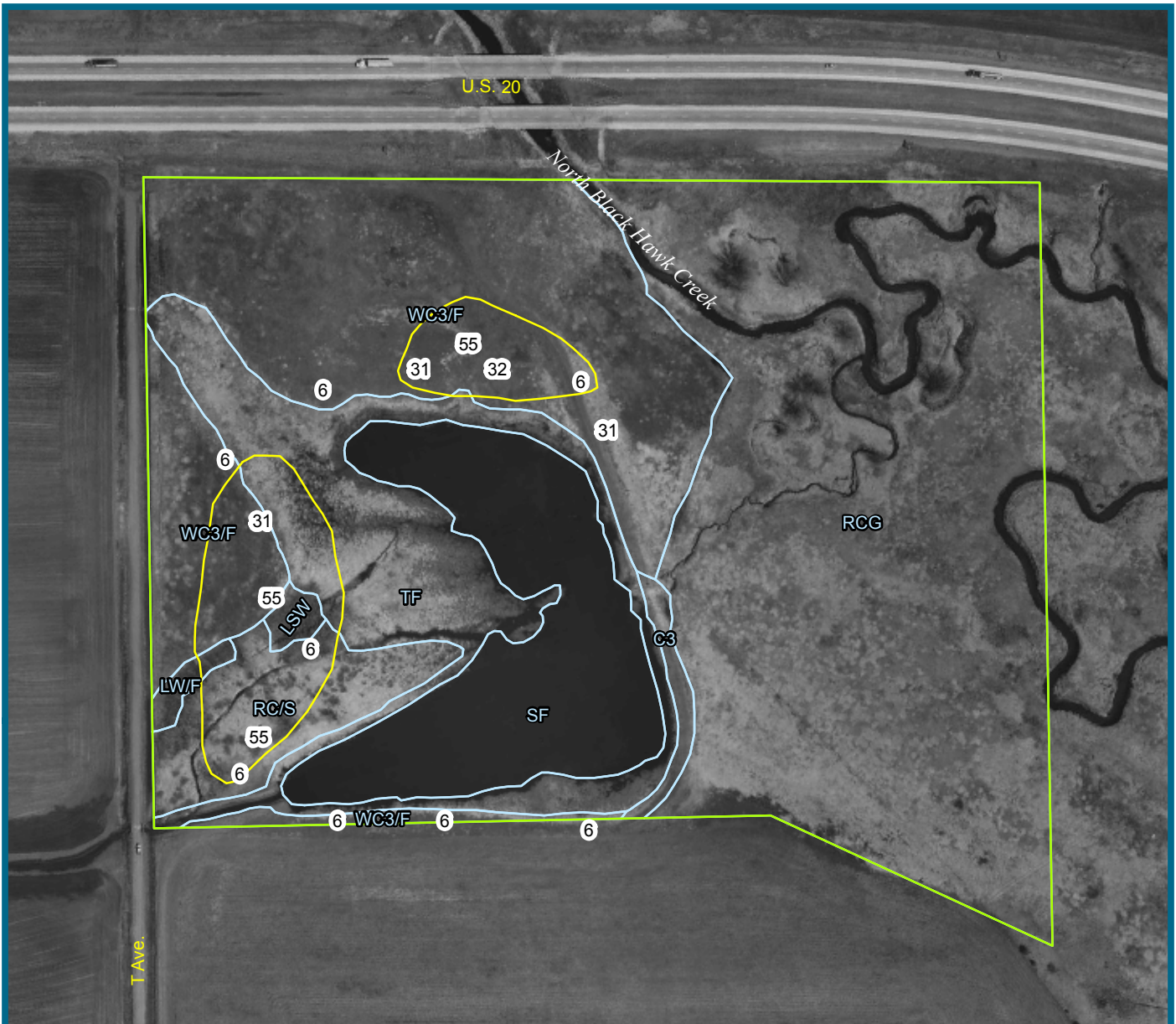
A **tyco** International Ltd. Company

Figure 4
Site No. 8 - Boevers

Jan 2008

45593

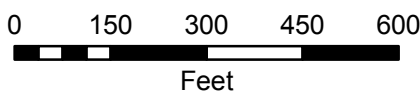




Key to Plant Communities

C3	Cool-season grassland
LSW	Lowlandshrubland/woodland
LW/F	Lowland woodland & forest
RC/S	Temporary flooded reed canary grass/shrubland
RCG	Temporary flooded reed canary grass
SF	Semi-permanently flooded wetland/aquatic
TF	Temporary/seasonally flooded wetland
WC3/F	Wet-mesic cool-season grass & forb

1 inch equals 300 feet



Aerial Photography Source: Iowa DOT 2006



55 Notable Sighting

- Hot Spot
- Site Boundary
- Vegetation Community

Notable Sightings Key

6	Ancyloxypha numitor
31	Lycaena hyllus
32	Satyrus titus
55	Limenitis archippus



A **tyco** International Ltd. Company

Figure 6
Site No. 12 - Dike

Jan 2008

45593

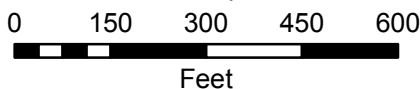
NE 118th Ave.



Key to Plant Communities

C3	Cool-season grassland
CT	Cattail
RC	Row crop
SF	Semi-permanently flooded wetland/aquatic
SM	Sedge meadow
TF	Temporary/seasonally flooded wetland
TFM	Tall forb meadow
TGP	Tallgrass prairie reconstruction
WC3/F	Wet-mesic cool-season grass & forb
WMP	Wet mesic prairie

1 inch equals 300 feet



Aerial Photography Source: Iowa DOT 2006 and USDA NAIP 2005

Notable Sightings Key

55	Notable Sighting	6	Ancyloxypha numitor
	Hot Spot	14	Anatrytone logan
	Site Boundary	16	Euphyes dion
	Vegetation Community	17	Euphyes conspicua
		18	Euphyes bimacula
		30	Lycaena dione
		31	Lycaena hyllus
		43	Boloria bellona
		55	Limenitis archippus



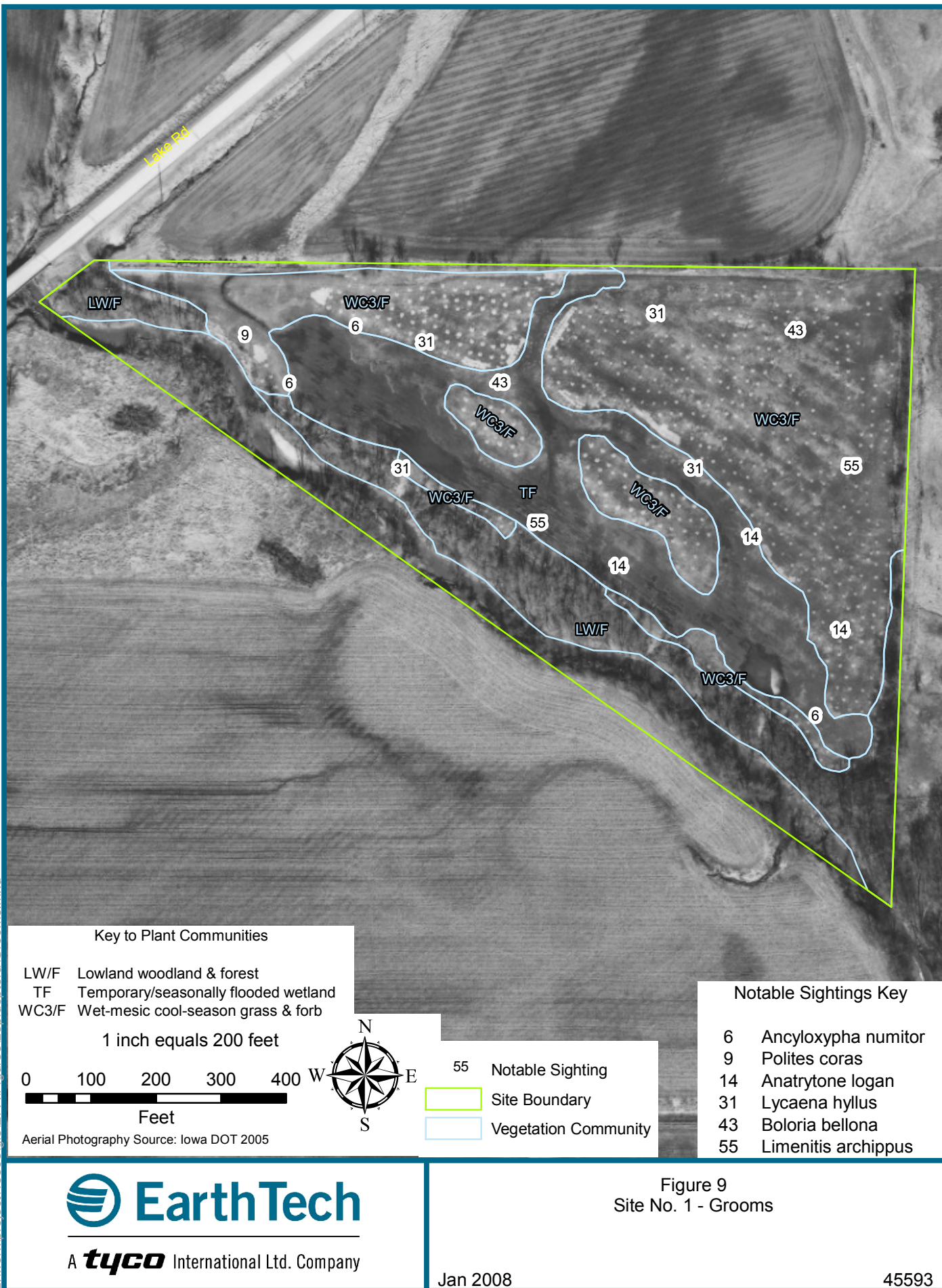
A **tyco** International Ltd. Company

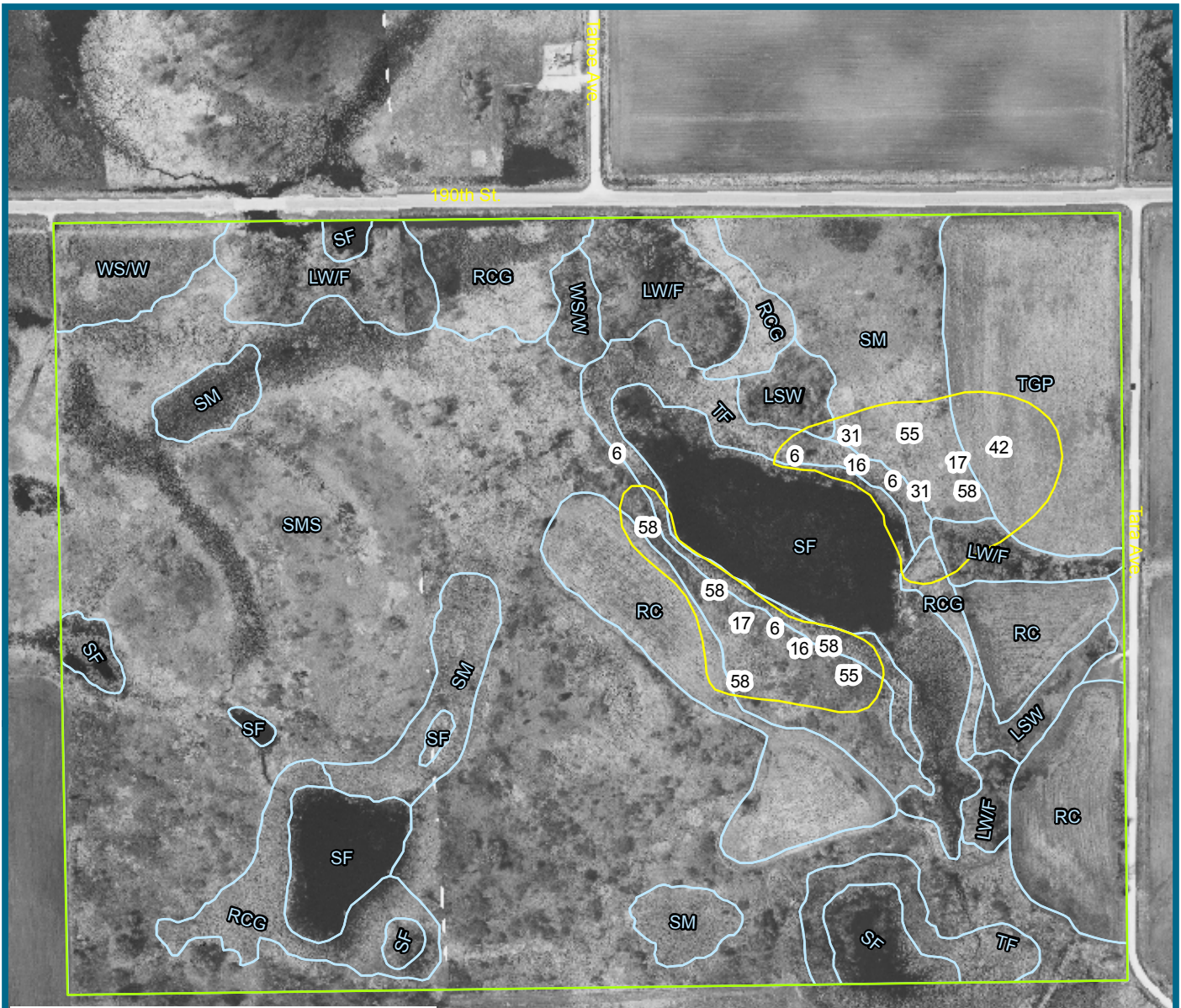
Figure 8
Site No. 13 - Engeldinger Marsh

Jan 2008

45593

L:\work\project\45593\gis\EPA\Figures\Epidoptera\Grooms.mxd

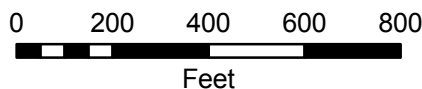




Key to Plant Communities

LSW	Lowland shrubland/woodland
LW/F	Lowland woodland & forest
RC	Row crop
RCG	Temporary flooded reed canary grass
SF	Semi-permanently flooded wetland/aquatic
SM	Sedge meadow
SMS	Sedge meadow/shrubland
TF	Temporary/seasonally flooded wetland
TGP	Tallgrass prairie reconstruction
WS/W	Wet shrubland-willow

1 inch equals 400 feet



Aerial Photography Source: Iowa DOT 2005 and USDA NAIP 2005

55 Notable Sighting

55	Notable Sighting
Hot Spot	
Site Boundary	
Vegetation Community	

Notable Sightings Key

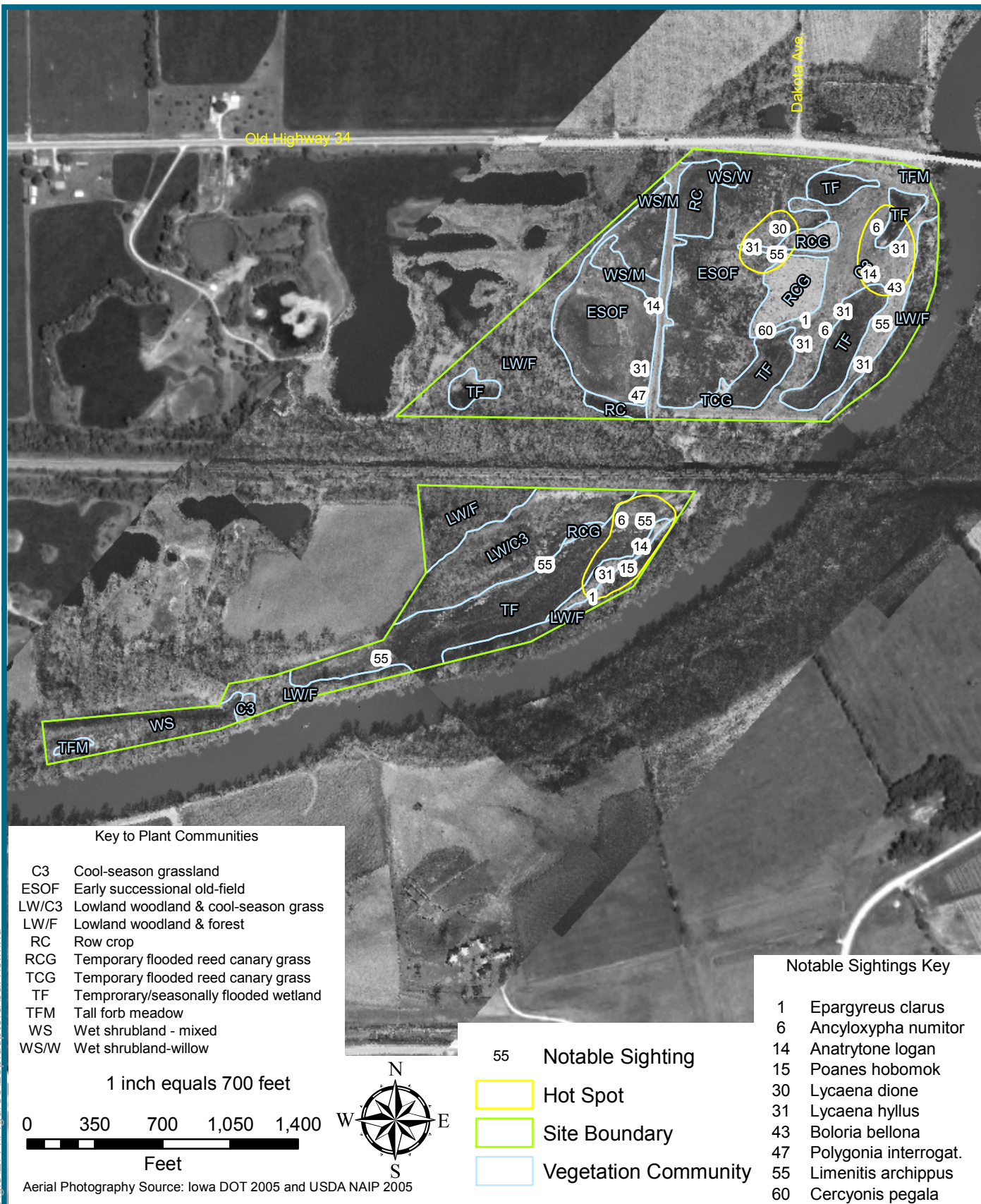
6	Ancyloxypha numitor
16	Euphyes dion
17	Euphyes conspicua
31	Lycaena hyllus
42	Boloria selene
55	Limenitis archippus
58	Satyrodes eurydice
59	Megisto cymela



A **tyco** International Ltd. Company

Figure 10
Site No. 14 - Hay-Buhr

L:\work\project\45593\gis\EP\Figures\lepidoptera\Jarvis.mxd



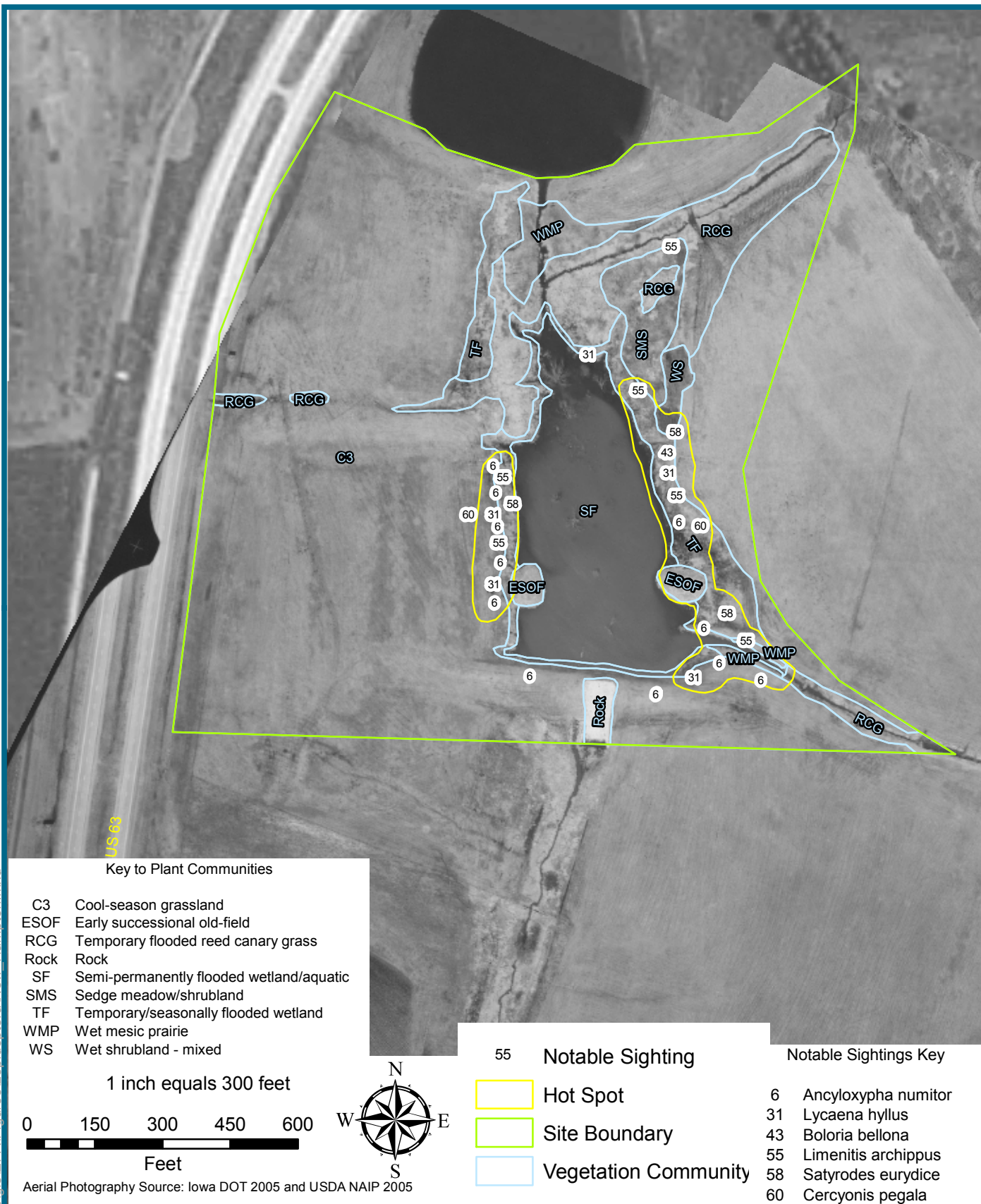
A **tyco** International Ltd. Company

Figure 11
Site No. 5 - Jarvis

L:\work\project\45593\gis\EP\Figures\epidoptera\Mink_Creek.mxd



L:\work\project\45593\gis\EPA\Figures\epidoptera\New Hampton.mxd



A **tyco** International Ltd. Company

Figure 13
Site No. 4 - New Hampton

Jan 2008

45593

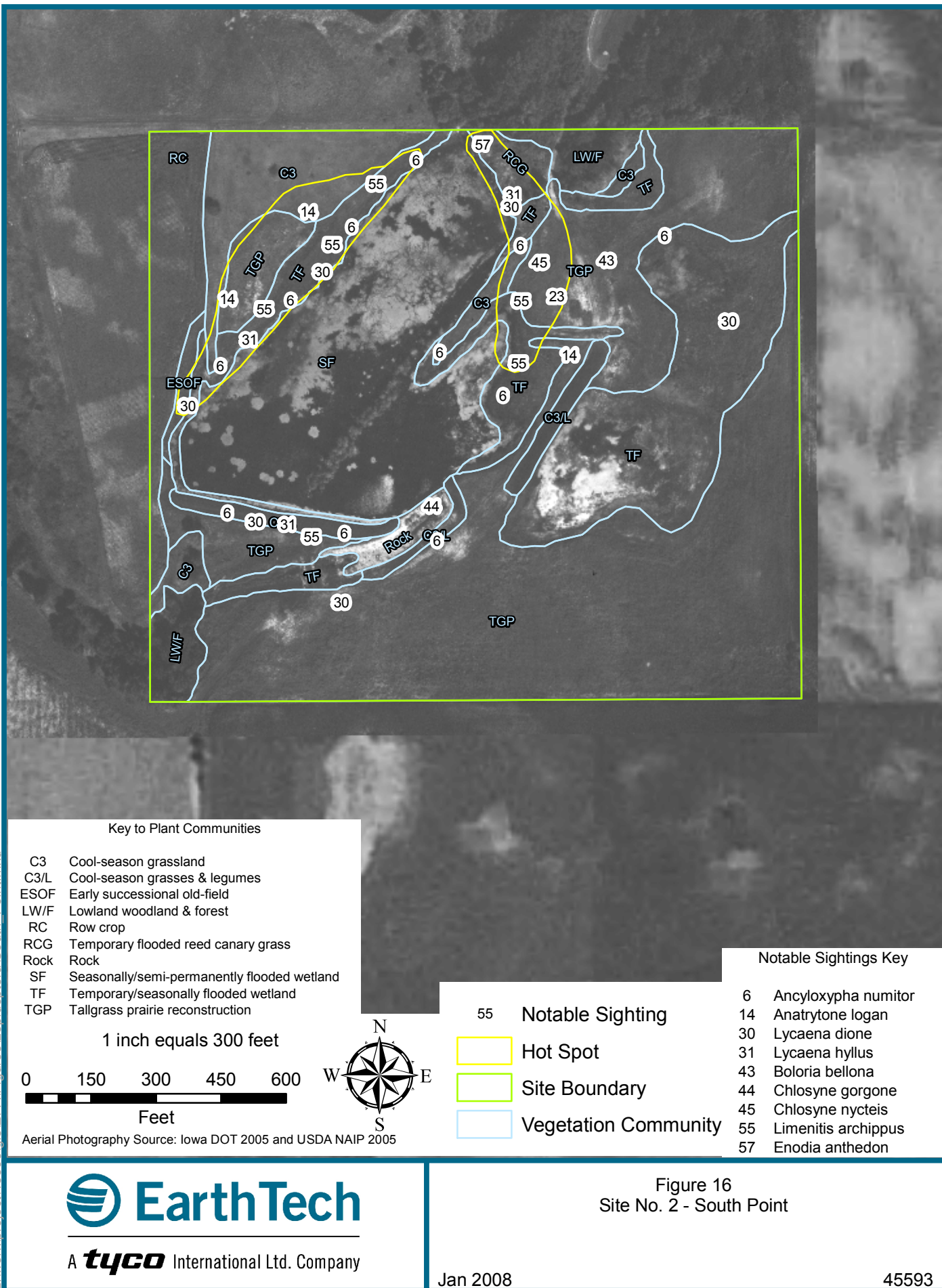
L:\work\project\45593\gis\EPA\Figures\epidoptera\Palisades.mxd



L:\work\project\45593\gis\EPAs\Figures\epidoptera\Pleasantville.mxd



L:\work\project\45593\gis\EPA\Figures\Lepidoptera\South_Point.mxd



A **tyco** International Ltd. Company

Jan 2008

45593

L:\work\project\45593\gis\EP\Figures\lepidoptera\Wickiup.mxd

